



ADR Salt Pill Design and Crystal Growth Process for Hydrated Magnetic Salts

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The innovation is a new, higher performance design for encapsulating hydrated paramagnetic salts, and a new process for growing these salts as refrigerant for very low temperature adiabatic demagnetization refrigerators (ADR). Hydrated salts are used in ADRs because of their low temperature capability. The challenge to using them is that their low thermal conductance requires the crystals to be grown from a solution onto a matrix of high thermal conductivity metal conductors (called a thermal bus) in an enclosure (called a salt pill) that can then be hermetically sealed. The salt pill design disclosed here makes use of automated machining processes to generate a regular array of conductors that is integrally connected to an external bolting surface for making thermal contact. The size and spacing of the conductors is set to provide very high thermal conductance to the salt while minimizing complications due to surface tension. A continuous counter flow technique is used where saturated solution flows into and depleted solution is withdrawn from the salt pill in a way that first nucleates crystallites at the bottom and then establishes controlled growth from the bottom upward until the entire container is filled with salt. The technique achieves very high fill fractions (98+ %) and, because it can be automated, rapid growth rates. The fabrication and salt growth techniques are suitable for mass production of salt pills for ADRs.

